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STUDY ON LEACHATE MANAGEMENT IN MUNICIPAL SOLID WASTE MANAGEMENT SYSTEM

Asheena Sunny [1] | Rashmishree K.N [2]

[1] Faculty Associate, Civil Dept, KIIT.

[2] Assistant Professor, Civil Department, Sahyadri College, Mangalore.

ABSTRACT

Municipal solid waste management is the collection, transport, processing or disposal, managing and monitoring of waste materials. We need to consider an effective leachate management for the development of efficient municipal solid waste management. Leachate means liquid that has percolated through municipal solid waste and contains dissolved and suspended materials from the solid waste. The present study was done by collecting the leachate samples from Mysore dumpy yard located in Karnataka. This study involves leachate sample analysis, control of leachate movement and proposal of a leachate management system. Through study an efficient management system for the leachate has been suggested.

KEYWORDS: municipal solid waste management, Mysore, Leachate management, Liners.

I. INTRODUCTION

Municipal solid waste management is one of the major environmental problems faced by Indian cities. Inappropriate municipal solid waste management system causes hazards to inhabitants. Various studies recommended that about 90% of the municipal solid waste is disposed of unscientifically in open dumps and landfills, creating problems to public health and the environment.

To implement proper waste management, various aspects have to be considered such as Waste generation (source reduction), proper collection, transport, processing or disposal, managing and monitoring of waste materials.

When water percolates through municipal solid waste, both biological and chemical materials are leached into the effluent. Leachate from the waste materials can be hazardous to human health and the environment because of the potential chemicals and pollutants it can contain. Preventing contamination to groundwater, surface water and soil is the main goal when managing leachate. If leachate is not managed properly, it can also result in odours, unsightly conditions, attract insects, and cause distress in vegetation.

The factors that influence leachate generation are precipitation volumes, landfill cover, type of waste deposited, vegetation, climate, and landfill design.

II. COMPOSITION OF LEACHATE

Leachate mainly consists of trace metals, major elements, organic compounds and microbiological components carrying both dissolved and suspended materials. Physico-chemical characteristics of the Leachate depend primarily upon the waste composition and water content in total waste. The characteristics of the Leachate samples collected from the Mysore dumpy yard has been presented in table 1.

Figure 1: Leachate in Mysore dumpy yard

Table 1: Composition of Leachate

Constituents	Result obtained	Permissible limit
BOD_5 (5-day biochemical oxygen demand)	1,9148 mg/l	2,000-30,000 mg/l
COD (Chemical oxygen demand)	6,3040 mg/l	3,000-60,000 mg/l
Total Dissolved solids (TDS)	2,1774 mg/l	584-55000 mg/l
Ammonium Nitrogen	2675 mg/l	<1200 mg/l
Nitrate	275 mg/l	< 250 mg/l
pH	6.18	3.7-8.9
Total hardness as $CaCO_3$	1000 mg/l	<600 mg/l
Chloride	1137 mg/l	2- 1135 mg/l
Sulfate	63 mg/l	<1850 mg/l
Iron	47 mg/l	<4000 mg/l
Electrical conductivity	24500 µS/cm	480 – 72,500 µS/cm
Total suspended solids	1,4772 mg/l	2 – 140,900 mg/l
Volatile suspended solids	1,4602 mg/l	50-50000 mg/l
Barium	230 µg/l	< 1 mg/l
Cadmium	205 µg/l	< 0.4 mg/l
Chromium	409 µg/l	<5.6 mg/l
Copper	153 µg/l	< 9 mg/l
Lead	288 µg/l	<14.2 mg/l
Mercury	175 µg/l	<0.4 mg/l
Nickel	131 µg/l	<7.5 mg/l
Selenium	175 µg/l	<0.05 mg/l
Silver	137 µg/l	<2 mg/l
Phenol	195 µg/l	1 mg/l

The pH value of leachate sample was found to be 6.18 and the sample is hard since hardness value is more than 600 mg/l. The relative high values of Electrical Conductivity (24500 µS/cm) and TDS (2,1774 mg/l) indicate the presence of inorganic material in the samples. The presence of high BOD (1,9148 mg/l) and COD (6,3040 mg/l) indicates the high organic strength. Among the nitrogenous compound, ammonia nitrogen (2675 mg/l) was present in high concentration, this is probably due to the deamination of amino acids during the decomposition of organic compounds. Small concentration of heavy metals also found in the Leachate sample. Hence the Leachate requires proper treatment.

III. CONTROL OF LEACHATE MOVEMENT

Liners are now commonly used to limit or eliminate the movement of Leachate and gases from the site. The use of clay as liner material has been the favored method of reducing or eliminating the seepage of Leachate. Clay has an ability to adsorb and retain many of the chemical constituents found in Leachate and its resistance to the flow of Leachate. Pictorial representation is shown in figure 2.

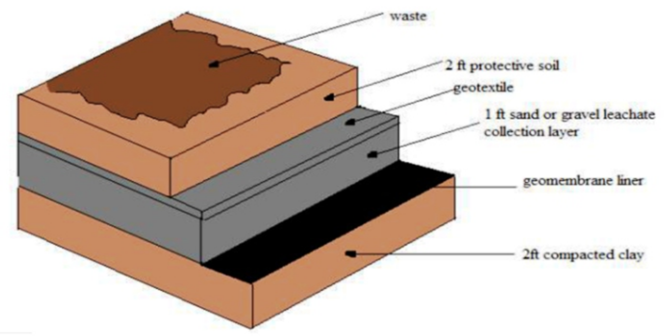

Figure 2: Control of Leachate in Landfill Area

IV. LEACHATE MANAGEMENT SYSTEM

Leachate that moves down through the municipal solid waste is first filtered as it passes the sand layer .The collected Leachate is transported to a treatment lagoon. The liquid in the lagoon is aerated to reduce the organic content and to control odours. Liquid from the lagoon is then applied to shredded municipal solid waste that is to be composted and used for intermediate cover material in the landfill. Application of the Leachate to the shredded municipal soild waste provides the moisture needed for optimum composting and reduces the volume of Leachate through evaporation.

Biological, Chemical and Physical processes and operations for the treatment of Leachate are:

Table 2: Biological processes

Treatment process	Application	comments
Activated sludge	Removal of organics	Defoaming additives may be necessary, separate clarifier needed
Sequencing batch reactors	Removal of organics	No separate clarifier needed, only applicable to relatively low flow rates
Aeration stabilization basins	Removal of organics	Requires large land area
Trickling filters	Removal of organics	Commonly used on industrial effluent similar to Leachate
Anaerobic lagoons	Removal of organics	Low power requirement and sludge production, require heating, slower than aerobic systems
Nitrification/de-nitrification	Removal of nitrogen	Nitrification/de-nitrification can be accomplished simultaneously with the removal of organics.

Table 3: Chemical processes

Treatment process	Application	comments
Neutralization	Control of Ph	Of limited applicability to most Leachate.
Precipitati-on	Removal of metals and some anions	Produces a sludge, possibly requiring disposal as a hazardous waste
Oxidation	Detoxification of some inorganic species ,Removal of organics	Works best on dilute waste streams, use of chlorine can result in formation of chlorinated hydrocarbons.
Wet air oxidation	Removal of organics	Costly, works well on refractory organics

Table 4 : Physical processes

Treatment process	Application	comments
Sedimentation /flotation	Removal of suspended matter	Of limited applicability alone, may be used in conjunction with other treatment
Filtration	Removal of suspended matter	Use as a polishing
Air stripping	Removal of ammonia or volatile organics	May require air pollution control equipment
Steam stripping	Removal of volatile organics	High energy costs, condensate steam requires further treatment
Adsorption	Removal of organics	Proven technology, variable costs depending on Leachate
ion exchange	Removal of dissolved inorganics	Useful only as a polishing step
Ultrafiltrati-on	Removal of bacteria and high molecular weight organics	Subject to fouling, limited applicability to Leachate
Reverse osmosis	Dilute solution of inorganics	Costly, extensive pretreatment is needed
Evaporation	Where Leachate discharge not permissible	Resulting sludge may be hazardous

V. CONCLUSIONS

It is important to note that no one single treatment method can manage all the leachate in an environmentally effective way. Thus all of the available treatment and disposal options must be evaluated equally and the best combination of the available options suited to the particular community can be chosen. Effective management schemes therefore need to operate in ways which will meet the current social, economic, and environmental conditions.

In this present study, by considering the recommendations an effective leachate management system has been suggested (figure 3); to ensure a clean environment in Mysore Dumpy yard.

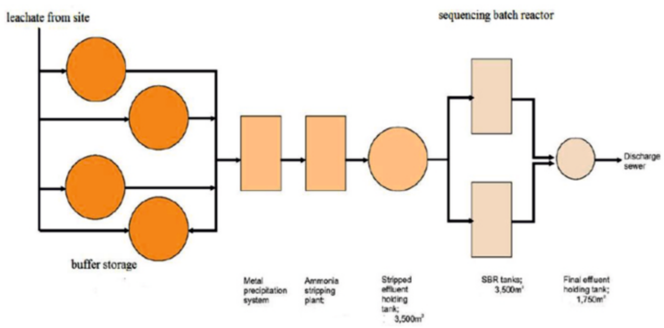

Figure 3: Flow diagram for proposed Leachate treatment

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